



**QUICK REVISION MODULE  
[UPSC PRELIMS 2022] GEOGRAPHY**

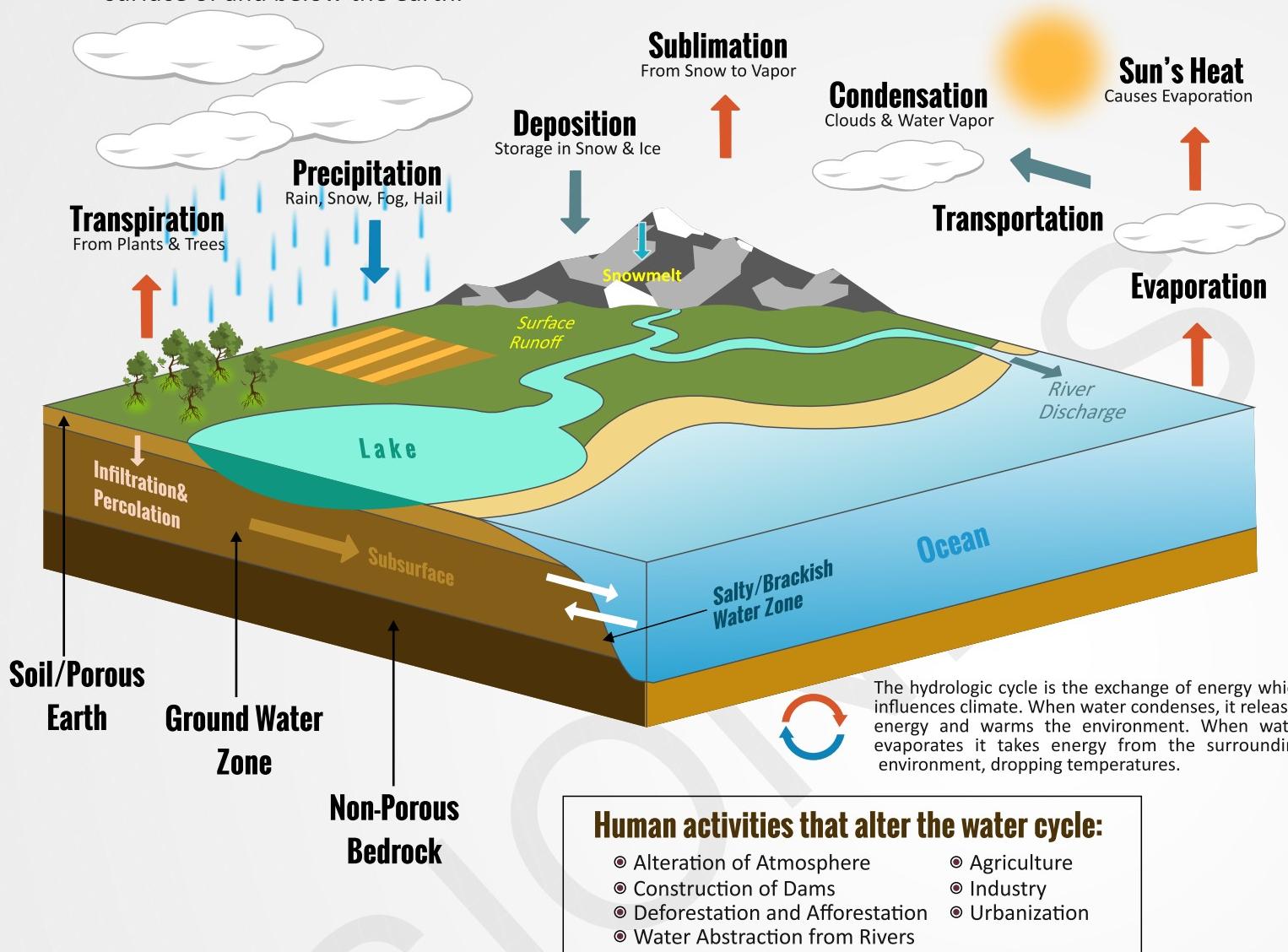
# **PRECIPITATION AND RELATED PHENOMENON**

## **Water Vapour Concepts and Water Cycle:**

- ▶ The water vapour constitutes about 2 percent of the total composition of the atmosphere.
- ▶ This percentage varies from zero percent in cold dry air of the Arctic regions during the winter season to as much as 5 percent of the volume in warm humid equatorial regions.
- ▶ The temperature of the atmosphere is the most important factor, as the capacity of the warm air to hold water vapour is more than that of the cold air.
- ▶ About half of the total moisture present in the atmosphere is concentrated in the lower layer of the atmosphere up to a height of about 2 kilometres.

## Hydrologic Cycle

The Hydrologic cycle (also called the water Cycle) is the continuous movement of water in the air, on the surface of and below the earth.



### Process Definitions:

#### Condensation

The transformation of water vapor to liquid water droplets in the air, creating clouds and fog.

#### Deposition

Also known as desublimation, is a thermodynamic process, a phase transition in which gas (vapor) transforms into solid (ice).

#### Evaporation

The transformation of water from liquid to gas phases as it moves from the ground or bodies of water into the overlying atmosphere.

#### Percolation

Water flows horizontally through the soil and rocks under the influence of gravity.

#### Precipitation

Condensed water vapor that falls to the Earth's surface. Most precipitation occurs as rain, but also includes snow, hail, fog drip, graupel, and sleet.

#### Sublimation

The state change directly from solid water (snow or ice) to water vapor.

#### Transpiration

The release of water vapor from plants and soil into the air. Water vapor is a gas that cannot be seen.

## Humidity and Related Concepts

**Humidity** refers to the amount of water vapour present in the atmosphere at a particular time and place. It can be expressed as an absolute, specific or a relative value.

The **Absolute Humidity** is the weight of actual amount of water vapour present in a unit volume of air. Generally, it is expressed as grams per cubic meter of air.

The **Relative humidity** is a better way of expressing the level of humidity in the air. It is the ratio of actual amount of water vapour present in air at a given temperature to the amount of water vapour air can hold at the same temperature. The Relative Humidity is expressed in percentages.



Absolute Humidity	Relative Humidity
It helps us to know the actual amount of water vapour present in air.	It shows the ratio of water vapour actually present in the air at a given temperature to the retentive capacity of humidity of the same parcel of air at the same temperature.
It does not take temperature into account.	It takes temperature into account.
It is expressed in grams per cubic metre.	It is expressed in percentages.
It is not a useful measure of humidity because it does not tell us the amount of water vapour required for the air to become saturated.	It is a useful measure of humidity because it can show how far the air is humid.

## Quick Concepts/Facts:

- The absolute humidity **decreases from the equator towards the poles**. Generally, the absolute humidity changes as air temperature or pressure changes. However, if temperature increases but there is no excess water for evaporation then absolute humidity will not change.
- The absolute humidity determines the amount of precipitation while the relative humidity tells us about the possibility of precipitation. The high and low relative humidity indicates the possibility of wet and dry conditions respectively. Evaporation decreases when there is high relative humidity & vice versa.
- The equatorial region is characterized by the highest relative humidity. Relative humidity gradually decreases towards the Tropical high-pressure belts (between 25°—35° latitudes). After this, the relative humidity again increases poleward.
- Relative humidity is maximum in the mornings and minimum in the evenings.

## Changes in Relative Humidity can occur in the following three ways:

- I. The temperature remaining the same and amount of water vapour in air increases. Its relative humidity will also increase.
- II. When the temperature of air rises its humidity retentive capacity also rises correspondingly and the Relative Humidity decreases.
- III. If the temperature of air decreases its humidity retentive capacity also decreases and Relative Humidity increases.

## Condensation and Its Types:

Once the condensation of water vapour in the atmosphere has taken place, the moisture present in the atmosphere may take one of the following forms— dew, frost, fog, mist, clouds

Key Concepts/Terms	Definitions/Important Pointers
 <b>Condensation</b>	The process of transforming of water vapour into water (liquid) and ice (solid) is called condensation. Condensation is level at which the air is not in a position to take up any more moisture.

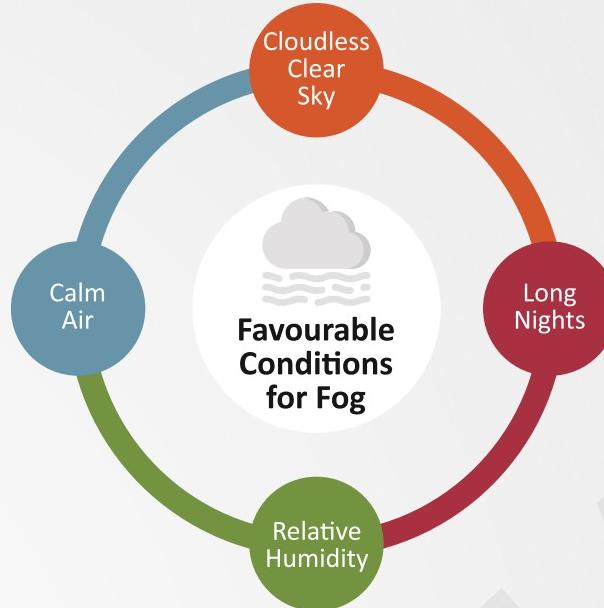


 <b>Latent Heat</b>	<p>At the time of evaporation, heat is absorbed and conserved in water vapour (This is why Evaporation leads to cooling). It is known as latent heat. Latent heat is essential for development of typhoons (storms, cyclones)</p>
 <b>Saturated Air</b>	<p>If at any given temperature the humidity retentive capacity of air equals its absolute humidity the air is said to be saturated. 100 percent humid air is called saturated air.</p>
 <b>Atmospheric Brown Cloud (ABC)/Asian Brown Cloud</b>	<p>The ABC originally referred to the enormous blanket of pollution spreading across Asia, distorting normal weather patterns in the region and threatening to devastate many countries' economies. It was called the 'Asian Brown Cloud' in 2002, when a UN report first warned of this layer of pollution comprising ash, acids and aerosols.</p>
 <b>The dew point</b>	<ul style="list-style-type: none"> <li>○ It is the temperature at which air is saturated with water vapor, which is the gaseous state of water. Below the dew point, liquid water will begin to condense on solid surfaces (such as blades of grass) or around solid particles in the atmosphere (such as dust or salt), forming clouds or fog.</li> <li>○ The relative humidity is 100 percent when the dew point and the temperature are the same.</li> </ul>
 <b>HAZE</b>	<ul style="list-style-type: none"> <li>○ Haze is traditionally an atmospheric phenomenon where dust, smoke and other dry particles obscure the clarity of the sky.</li> <li>○ One way to distinguish between smog and naturally-occurring haze is by colour. Natural haze is typically white, Gray or even blue. Smog is almost always yellowish or brown in colour.</li> <li>○ The international definition of fog is a visibility of less than 1 kilometre; mist is a visibility of between 1 kilometre and 2 kilometres and haze from 2 kilometres to 5 kilometres .</li> <li>○ Fog and mist are generally assumed to be composed principally of water droplets, haze and smoke can be of smaller particle size.</li> </ul>

<b>Dew</b>	<b>Frost</b>
It can be seen as droplets of water on leaves of small plants or blades of grass.	It can be found on solid surfaces of earth's crust as ice or snow crystal.
It is formed when temperature of dew point is above freezing point.	It is formed when temperature is below freezing point.
It is useful for plants.	It is harmful for plant growth.



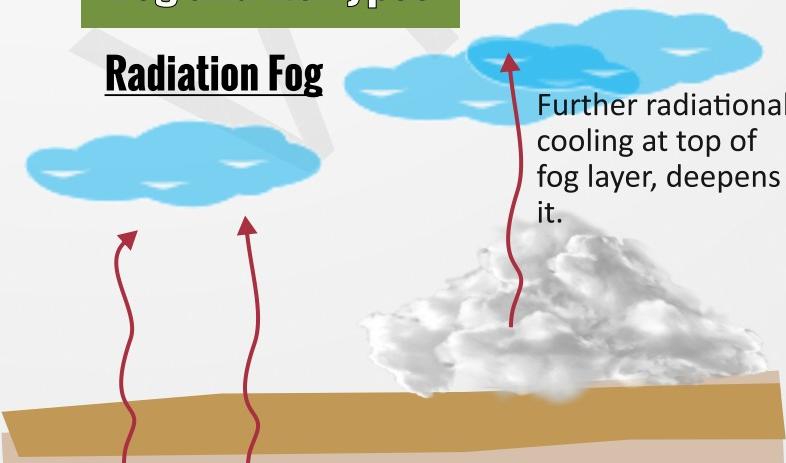
## Fog, Mist and Its Favourable Conditions:



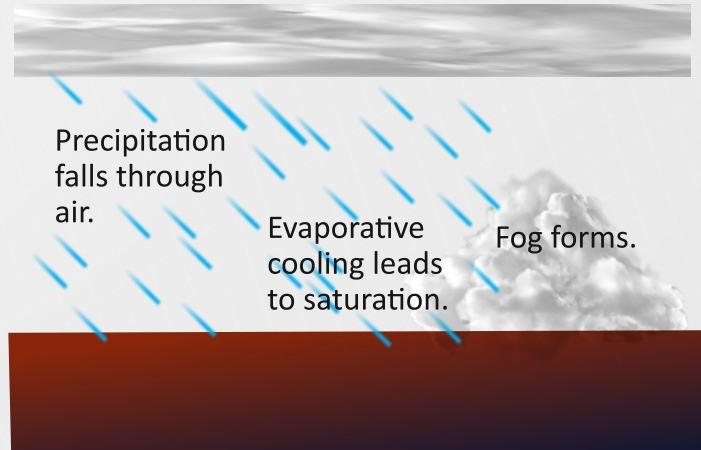
Fog	Mist
Fog is a special type of thin cloud consisting of very small water droplets which remain suspended in air close to the surface of the Earth.	It is also a type of fog but is relatively less dense. The only difference between mist and fog is density and its effect on visibility.
A cloud that reduces visibility to less than 1 km is called fog, whereas	It is called mist if visibility range is between 1 and 2 km.
Fogs are drier than mist and they are prevalent where warm currents of air come in contact with cold currents	Mists are frequent over mountains as the rising warm air up the slopes meets a cold surface.
Fog is formed due to condensation of water droplets suspended in the atmosphere in the vicinity of the earth's surface under certain conditions, such as low temperature and high relative humidity	Mist can occur as part of natural weather or volcanic activity or could be created artificially.

## Fog and its Types

### Radiation Fog



### Precipitation Fog





## Advection Fog



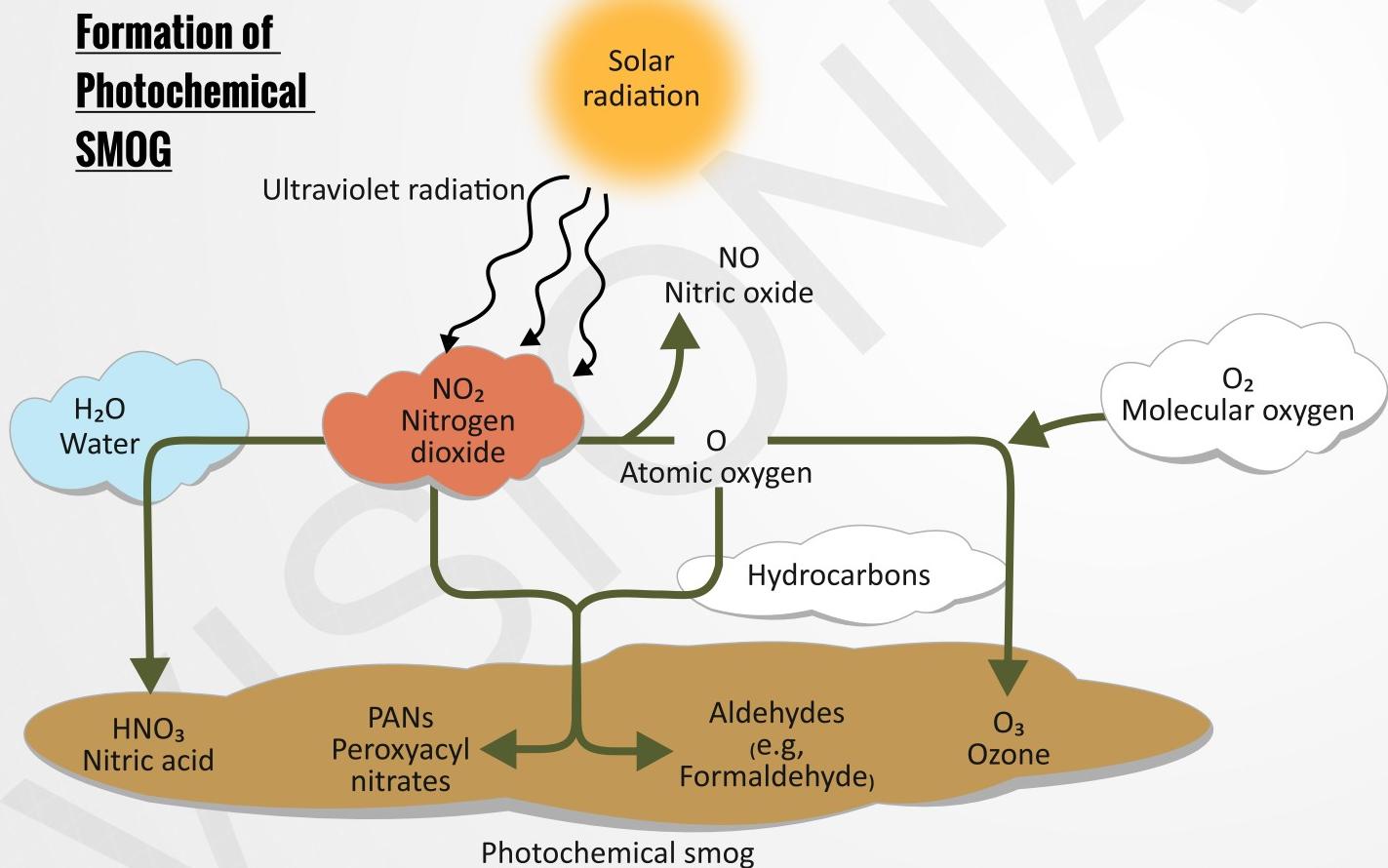
Warm, moist air moves, or advects, over a cold surface (layer of snow, body of water).

The air cools to its saturation point, at that time fog develops.

## Smog and Types-

It refers to a mixture of smoke and fog. It also results from sun's effect on certain pollutants in the air, notably those from automobile exhaust. There are two main types of smog— photochemical and industrial.

### Formation of Photochemical SMOG



The industrial smog is a mixture of sulphur dioxide and a variety of solid and liquid particles suspended in air. It comes from the stationary sources, such as furnaces, power plants, etc., than from motor vehicles. Sulphur dioxide in combination with water and oxygen can turn into sulphuric acid in the atmosphere and falls on the earth as acid rain.

<b>Name:</b>	Industrial smog (New York smog, Gray smog)	Photochemical smog (Los Angeles smog, Denver smog, Brown smog)
<b>Weather:</b>	Cool, Damp	Sunny
<b>Content:</b>	Particulates, Sulfur oxides	$\text{NO}_x$ , Ozone, Hydrocarbons, PAN
<b>Sources:</b>	Coal	Gasoline(Petrol), Combustion



# Clouds and Its Types

## Where is cloud nine?

### There are 10 basic cloud types

Clouds are made up of tiny water droplets and ice crystal, formed through the process of condensation, that are so small they can float in the air. If the droplets become large enough, they fall as precipitation. Clouds are given names based on their shape and their height in the sky. Cloud elevations range from near the ground to almost as high as jets fly. Some are puffy, like cotton others are grey and uniform.

#### HIGH

- 10** **Cirrus** clouds (**above 18,000 ft.**) are made of ice crystals and look like long, thin, wispy white streamers high in the sky. Often seen during fair weather.



- 8** **Cirrocumulus** clouds (**above 18,000 ft.**) are small rounded puffs. Usually white and appear in long rows high in the sky. Common in winter, indicating fair but cold weather.



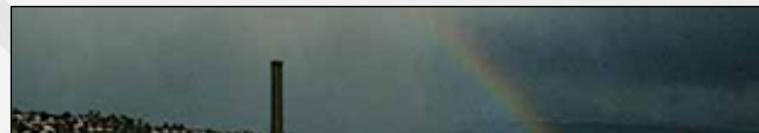
- 9** **Cirrostratus** clouds (**above 20,000 ft.**) are high, thin sheet - like clouds. Usually cover the entire sky and come 12 to 24 hours before a rain or snowfall.

#### MIDDLE

- 7** **Altostatus** clouds (**6,000 to 20,000 ft.**) are mid-level, gray or blue-gray clouds. Usually cover the whole sky and may precede a storm with continuous rain or snow.



- 5** **Nimbostratus** clouds (**below 10,000 ft.**) are dark gray, have ragged bases and sit low in the sky. Associated with continuous rain or snow. Sometimes cover the whole sky.



- 6** **Altocumulus** clouds (**6,000 to 20,000 ft.**) are mid-level, grayish-white, with one part darker than the other. Usually form in groups and may precede a thunderstorm.

#### LOW

- 4** **Cumulonimbus** clouds (**from near the ground to 50,000 ft.**) can extend very high. Thunderstorm clouds associated with heavy rain, snow, hail, lightning and sometimes tornadoes.



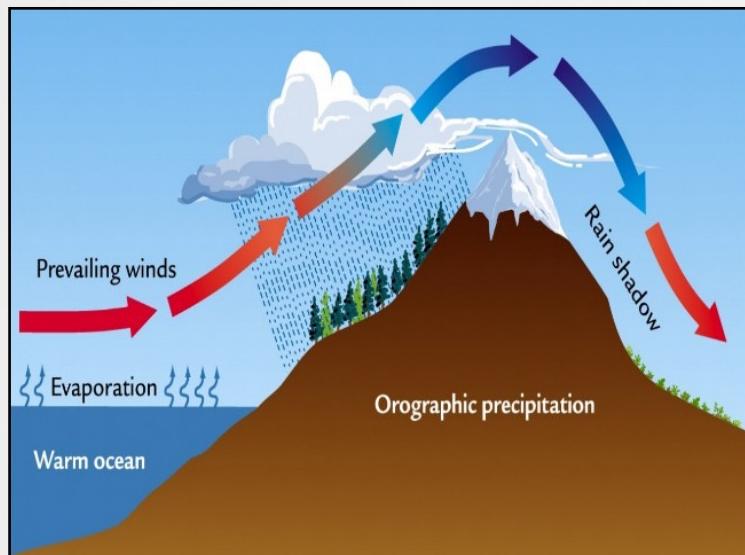
- 3** **Cumulus** clouds (**below 6,000 ft.**) have vertical growth with puffy white or light gray clouds that look like floating cotton balls. A base height of 1000 meters. Associated with fair or stormy weather.

- 2** **Stratocumulus** clouds (**below 6,000 ft.**) are low, lumpy, and gray. Only light rain (usually drizzle) falls from stratocumulus clouds.

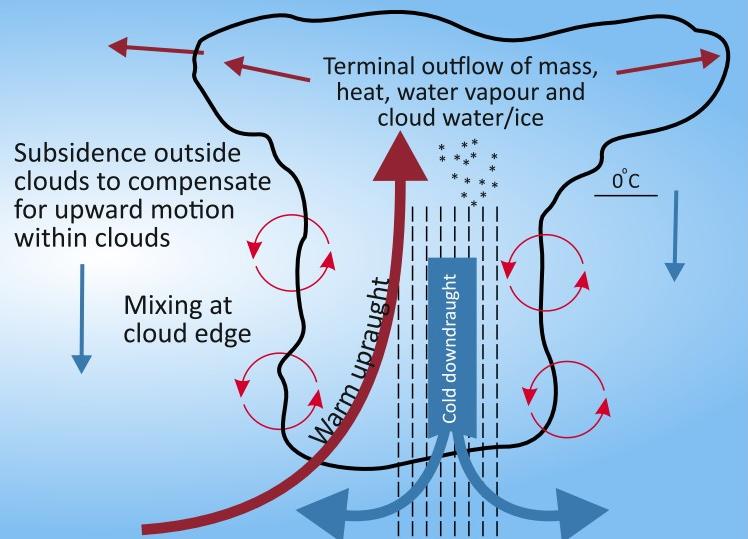


- 1** **Stratus** clouds (**below 6,000 ft.**) are low and a uniform gray in color. Can look like a fog that doesn't reach the ground. Sometimes produce light mist or drizzle.

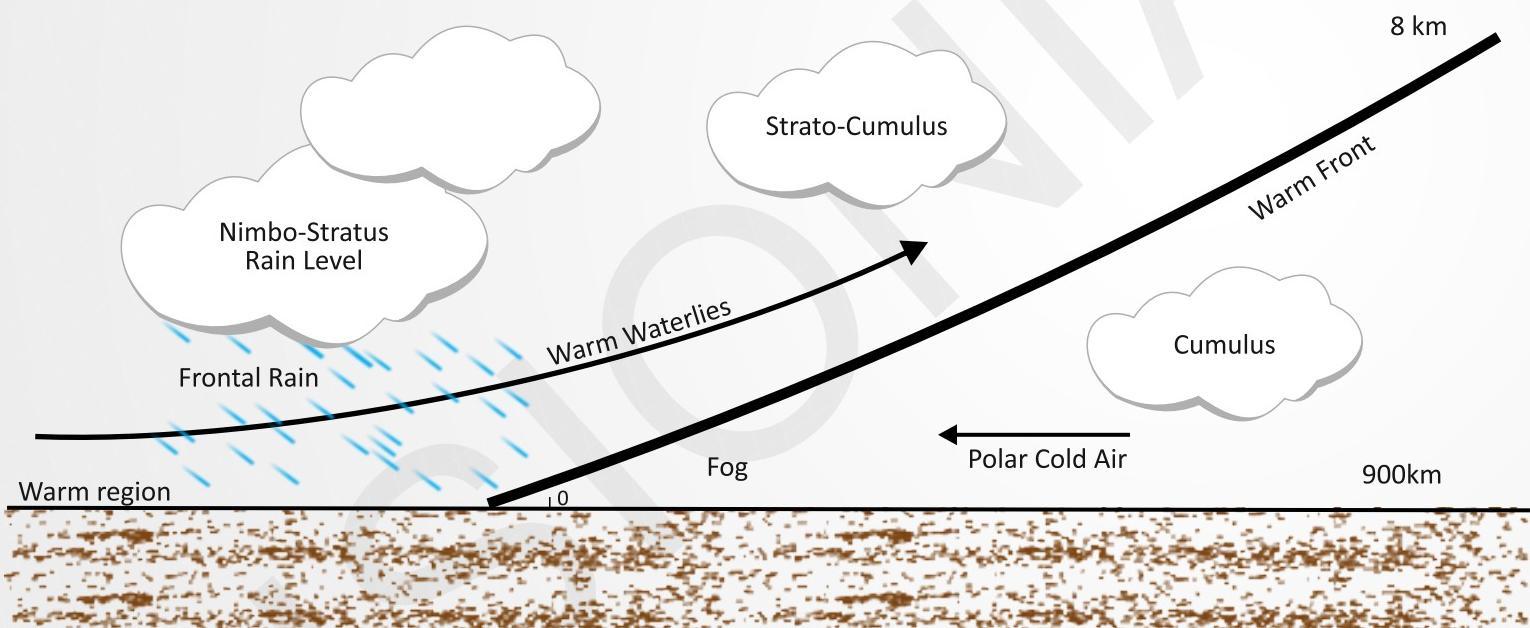
## Types of Rainfall



**Orographic Rainfall**



**Cyclonic/ Convectional Rainfall**



**Frontal Rainfall**

## Ten Types of Precipitation

Precipitation in the form of slowly falling, singular ice needles, columns or plates.

### Ice Crystals

Rain  
Liquid precipitation that reaches the surface in the form of drops greater than 0.5 millimeters in diameter.

Sleet  
Small bits of frozen rain drops, also known as ice pellets that rebound after striking the ground or any other hard surface.

Snow  
Ice crystals forming into flakes at temperature below freezing.

### Freezing rain

Precipitation that falls in liquid as rain drops or snow and immediately freezes as it hits the surface.

### Snow grains

Small grains of ice that do not produce much accumulation and are solid equivalent to drizzle.

Dense precipitation that comes in the form of balls or irregular pieces of ice and are at least 5 millimeter in diameter.

### Hail

Fog composed of supercooled water drops that freezes just after they wet the earth's surface.

### Freezing fog

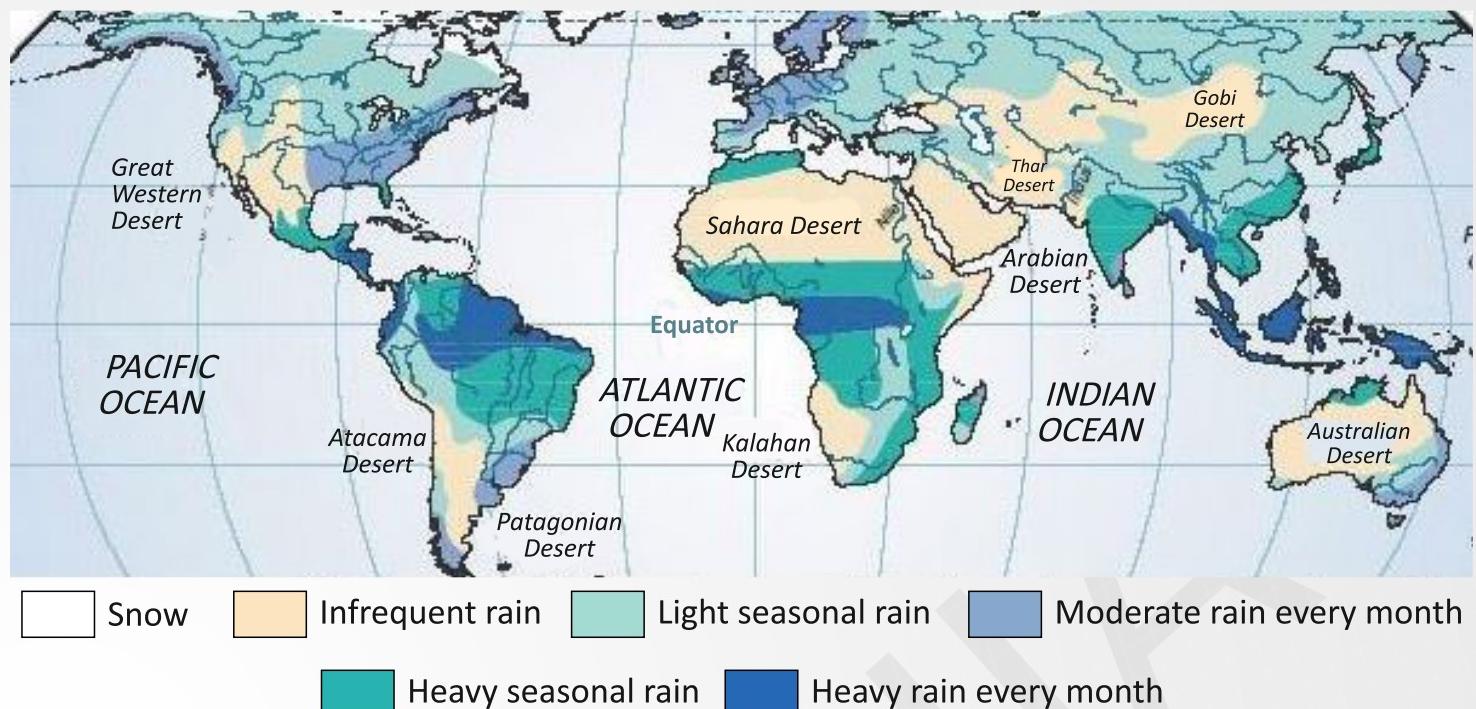
Liquid precipitation that reaches the surface in the form of drops that are less than 0.5 millimeter in diameter.

### Drizzle

Forms in the same way as hail except the diameter is less than 5 millimeters.



## Global Distribution of Precipitation



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**DELHI**



**LUCKNOW**



**JAIPUR**



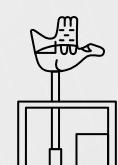
**HYDERABAD**



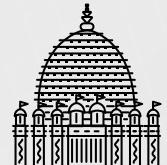
**PUNE**



**AHMEDABAD**



**CHANDIGARH**



**GUWAHATI**